Congenitally missing mandibular second premolars: Clinical options

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Introduction: Congenital absence of mandibular second premolars affects many orthodontic patients. The orthodontist must make the proper decision at the appropriate time regarding management of the edentulous space. These spaces can be closed or left open. Implications: If the space will be left open for an eventual restoration, the keys during orthodontic treatment are to create the correct amount of space and to leave the alveolar ridge in an ideal condition for a future restoration. If the space will be closed, the clinician must avoid any detrimental alterations to the occlusion and the facial profile. Significance: Some early decisions that the orthodontist makes for a patient whose mandibular second premolars are congenitally missing will affect his or her dental health for a lifetime. Therefore, the correct decision must be made at the appropriate time. Purpose: In this article, we present and discuss various treatment alternatives for managing orthodontic patients with at least 1 congenitally missing mandibular second premolar. (Am J Orthod Dentofacial Orthop 2006;130:437-44)

Congenital absence of mandibular second premolars affects many orthodontic patients. The orthodontist must make the proper decision at the appropriate time regarding management of the edentulous space. These spaces can be closed or left open. If the space will be left open for an eventual restoration, the keys during orthodontic treatment are to create the correct amount of space and to leave the alveolar ridge in an ideal condition for a future restoration. If the space will be closed, the clinician must avoid any detrimental alterations to the occlusion and the facial profile. Some early decisions that the orthodontist makes for a patient whose mandibular second premolars are congenitally missing will affect his or her dental health for a lifetime. Therefore, the correct decision must be made at the appropriate time. We present and discuss various treatment alternatives for managing orthodontic patients with at least 1 congenitally missing mandibular second premolar.

PATIENT 1

A girl, age 12 years 4 months, was congenitally missing the mandibular right second premolar. The deciduous right second molar was present but submerged below the occlusal levels of the adjacent teeth (Fig 1, A). The radiograph of the deciduous tooth showed that the bone levels between the deciduous molar and the adjacent permanent teeth were flat (Fig 1, B). This indicated that the deciduous tooth was not ankylosed and had erupted evenly with the adjacent teeth. The mesiodistal width of the deciduous molar was 13 mm (Fig 1, C); the normal width of an average mandibular second premolar is 7.5 mm. Although a single-tooth implant was the planned replacement for the missing premolar, the patient was too young and still growing. To preserve the buccolingual bone for an eventual implant, the deciduous molar was reduced in width (Fig 1, D and E) and restored with composite (Fig 1, F and G), and the remaining space was closed to produce Angle Class I molar and canine relationships after orthodontic therapy (Fig 1, H and I).

PATIENT 2

A girl, age 8 years 3 months, had bilateral submerged mandibular second molars (Fig 2, A). The radiograph (Fig 2, B) showed that the bone levels between the right deciduous second molar and the adjacent permanent first molar were angled or oblique, indicating that the permanent tooth had continued to erupt. All remaining deciduous teeth were extracted, no space-maintaining appliances were placed, and the remaining permanent teeth were allowed to erupt (Fig 2, C). Even though a significant vertical bony defect remained immediately after extraction of the submerged deciduous molar, subsequent tooth eruption brought the bone and tissue up...
to their normal levels (Fig 2, D) and eliminated the alveolar defect. Because the mandibular incisors were located so far to the lingual aspect (Fig 2, E), they were proclined labially, and space was opened between the premolar and the molar (Fig 2, F) for a single-tooth implant (Fig 2, G). This implant was restored with a second premolar crown (Fig 2, H), which helped to reestablish proper occlusion (Fig 2, I). The bone for the implant was created through orthodontic implant-site development.

PATIENT 3

This woman was missing her right mandibular second premolar and first molar. The mandibular second molar was in an Angle Class II relationship with the maxillary first molar (Fig 3, A), and the edentulous space between the second molar and the first premolar (Fig 3, B) was too large for 1 tooth and too small for 2 teeth. After initial orthodontic alignment (Fig 3, C), a diagnostic wax-up was constructed to determine the precise position for a second premolar implant (Fig 3, D). After integration of the implant, a provisional crown was attached (Fig 3, E), and a bracket was placed on the implant-supported crown (Fig 3, F). The implant was used as an anchor to move the right mandibular second molar mesially into an Angle Class I relationship, without jeopardizing orthodontic anchorage, the position of the remaining anterior teeth (Fig 3, G), or the patient’s facial profile. The final porcelain crown on the implant (Fig 3, H) was the appropriate size, and the eventual posttreatment occlusion was finished in an ideal Angle Class I relationship (Fig 3, I). The maxillary second molar was left without an occlusal antagonist. If the maxillary second molar eventually supererupts, it can be extracted, or an implant can be placed distally to the mandibular second molar. Using
the implant as an anchor for partial closure of a 2-tooth space minimized the complexity of the orthodontic treatment and the restorative management for this patient.

PATIENT 4

This girl, age 13 years 8 months, had an Angle Class II malocclusion, with a 5-mm anterior overjet (Fig 4, A). She had a minor arch-length deficiency in both arches but was congenitally missing the right maxillary, and right and left permanent mandibular second premolars (Fig 4, B). Her maxilla and mandible were well related (Fig 4, C), and the maxillary and mandibular incisors were in a relatively normal antero-posterior position. Extraction of the left maxillary second premolar and remaining deciduous second molars and closure of all edentulous spaces would have been detrimental to her facial profile by overly retracting the lips relative to the chin. The only options for avoiding the incisor retraction were placement of mini-implants for anchorage to protract the maxillary and mandibular first molars, and extraoral anchorage to achieve the same objective. Because this patient was treated before the era of mini-implants, a chincup and elastics were used to slide the maxillary and mandibular first molars mesially along a continuous archwire. The posttreatment dental casts (Fig 4, D) show that an Angle Class I molar relationship was achieved. The panoramic radiograph (Fig 4, E) shows the amount of tooth movement, and the cephalometric superimposition before and after orthodontic treatment (Fig 4, F) verifies that the mandibular incisors did not move lingually, but that the mandibular molars moved entirely mesially with the protraction force. Although this tooth movement required 4 years of orthodontic treatment, the patient has no restorations, and her facial

Fig 2. A and B, Girl was missing permanent right and left mandibular second premolars; deciduous first and second molars were ankylosed and submerged. C and D, All deciduous molars were extracted; permanent first premolar and first molar drifted together and closed the space. E-H, Because mandibular incisors were positioned lingually relative to chin, treatment plan involved opening second premolar space, followed by placement of implant and porcelain crown. I, Treatment plan resulted in Angle Class I molar and canine relationships.
profile was maintained despite the 3 congenitally missing premolars.

PATIENT 5

This girl, age 14 years 6 months, was congenitally missing her left mandibular second premolar (Fig 5, A), and the deciduous second molar was ankylosed and submerged. The left maxillary second premolar was present but delayed in its eruption. After the deciduous second molar was extracted, substantial bone resorption with significant vertical and buccolingual narrowing of the alveolar ridge occurred (Fig 5, B). This ridge defect would probably have narrowed even further and required a bone graft before implant replacement. However, another approach involved moving the first premolar into the second premolar position (Fig 3, C–E); this created an adequate ridge for the first premolar implant. When the flap was elevated to place the implant, sufficient alveolar bone was located distally to the premolar where the ridge had been deficient (Fig 5, F). By using the adjacent tooth as the stimulus for alveolar-site development, no bone graft was necessary when the implant was placed at 17 years of age, after cephalometric superimpositions showed that her facial growth was completed (Fig 5, G). The final crown on the mandibular implant (Fig 5, H) provided the proper space and support for the occlusion, and the first premolar functions nicely in the second premolar position (Fig 5, I).

DISCUSSION

Congenital absence of mandibular second premolars affects many orthodontic patients. The clinician must make the proper decision at the appropriate time regarding management of the edentulous space. If the space will be left open for an eventual restoration, the correct
amount of space must be created and the alveolar ridge must be left in an ideal condition for a future restoration. In the past, either conventional bridges or resin-bonded bridges were used to fill edentulous spaces. However, full-coverage conventional bridges in young patients can result in devitalization of the pulp and require root canal therapy. Resin-bonded posterior bridges have questionable survival rates. Today, the first choice of restoration for a congenitally missing mandibular premolar should be a single-tooth implant. But if the implant cannot be placed until the patient’s facial growth is complete, how should the edentulous ridge be preserved?

Ostler and Kokich evaluated the long-term changes in the width of the alveolar ridge after extracting deciduous mandibular second molars. Their data showed that the ridge narrows by 25% during the first 4 years after deciduous tooth extraction. After 7 years, the ridge narrows another 5%, for a total reduction of 30% over 7 years. However, the authors showed that these ridges were still broad enough to receive a dental implant. Unfortunately, the ridge resorbs more on the facial side than on the lingual side, and, therefore, although the implant can be placed without a bone graft, the implant position is more to the lingual side. This factor requires the restorative dentist to alter the loading of the buccal and lingual cusps of the crown on the implant to prevent fracture of the abutment or the implant crown.

Another option is to maintain the deciduous tooth until the patient is old enough for the implant. The appropriate age for implant placement is determined by the cessation of vertical facial growth. That parameter is determined by comparing serial cephalometric radiographs to determine when ramus growth and therefore vertical changes in facial growth have stopped. Fudalej et al showed that, on average, girls’ facial growth continues until about 17 years of age, whereas the average boy’s facial vertical growth is complete at about 21 years of age. Therefore, maintaining the deciduous tooth until the end of growth is desirable. But deciduous molars are too wide mesiodistally, and this could affect the fit of the posterior teeth. Thus, it is advantageous to reduce the width of the deciduous second molar to the size of a second premolar.

The reduction of a deciduous molar should be accomplished with a sharp carbide fissure bur or a diamond bur. The key is to remove sufficient tooth structure to create space but not enough to cause pulpal necrosis. A guide to estimating the correct amount of reduction is to measure the mesiodistal width of the deciduous molar at the level of the cementoenamel junction on a bitewing radiograph (Fig 1). This distance can be transferred to and marked on the occlusal surface of the deciduous molar with a pencil or marking pen. Then the bur is positioned to follow this line and cut toward the gingiva to remove a wafer of enamel and the underlying dentin on both the mesial and distal
surfaces (Fig 1). About 2 mm can be removed from both surfaces; this should leave the crown about 7 to 8 mm wide.

A potential problem of reducing the deciduous molar in this way is that it leaves exposed dentin on the mesial and distal surfaces of the tooth. As the spaces are closed, it is difficult for the patient to adequately clean these interproximal surfaces, and the tooth could decay easily. Therefore, to prevent decay, a layer of light-cured restorative composite should be applied to the mesial and distal surfaces to protect the deciduous tooth. In addition to protecting these exposed dentinal surfaces, the addition of restorative composite will build up the occlusal surface of the typically short deciduous molar, so that it can function with the teeth in the opposing dental arch and prevent supereruption. After composite restoration, the interproximal spaces can be closed, and the deciduous molar functions as a premolar (Fig 1).

A common concern about closing these interproximal spaces after reduction of the deciduous tooth is that its roots will prevent complete space closure, because they tend to diverge beyond the width of the crown. However, in most cases, as the socket wall of the permanent teeth move near and into contact with the deciduous tooth roots, the latter will resorb. After resorption, these deciduous roots are replaced by bone; this is an ideal way to prepare this site for a future implant.1

Occasionally, a deciduous second molar becomes ankylosed. If the ankylosis occurs while the patient is young and still undergoing significant facial growth, the tooth will become submerged relative to the adjacent erupting permanent teeth.5 If this region will be restored with a future implant, the alveolar ridge could be compromised vertically and require a bone graft.10 However, vertical bone grafting is often unpredictable and an added expense for the patient.11 Therefore,
extraction of ankylosed deciduous molars is recommended, if the patient is missing the deciduous second molar and the face is still growing. But how does the clinician diagnose ankylosis in a child or an adolescent? The most reliable indicator of deciduous molar ankylosis is to evaluate the alveolar bone levels between the deciduous molar and the adjacent permanent first molar and first premolar. If the bone is flat, this indicates that the deciduous tooth and the adjacent teeth are erupting evenly. However, if the alveolar bone level becomes oblique, with the bone level located more apically around the deciduous tooth, this confirms ankylosis (Fig 2). If the patient has little facial growth remaining, and the deciduous molar is submerged only slightly, the tooth can be maintained to preserve the width of the alveolus for the future implant. However, if the patient has significant growth remaining, the deciduous molar must be extracted to prevent a significant ridge defect.

A common question after deciduous molar extraction is whether to place a space maintainer to preserve arch length. We do not place space maintainers in most of these situations, especially if implants will be used for restoring the edentulous space. If the edentulous space is not maintained, the adjacent permanent first molar and first premolar should erupt together (Fig 2). Although this could require longer orthodontic treatment to push the teeth apart to create the implant space, this type of tooth movement will also result in a more robust alveolar ridge (Fig 2). As the roots of adjacent teeth move apart, they deposit bone behind that equals the width of the premolar and molar, and will produce an excellent ridge in which to place the implant. This process is called orthodontic implant-site development.

Occasionally, the decision to extract an ankylosed and submerged deciduous second molar will be made too late, resulting in a narrow alveolar ridge with a vertical defect. If an implant will be placed in this site, a bone graft might be necessary to provide adequate ridge width and height. However, another possibility exists, especially if the patient will undergo orthodontic therapy. It might be advantageous to push the first premolar into the second premolar position, thereby creating space for the single-tooth implant in the first premolar location. When faced with this decision, clinicians are often fearful that there is insufficient alveolar ridge width in which to move the permanent first premolar. However, previous studies showed that a wider tooth root can be pushed through a narrow alveolar ridge without compromising the eventual bone support around the repositioned tooth root. We performed this type of tooth movement on several occasions, and it resulted in a much better ridge in which to place the implant (Fig 5).

Another possible situation is a patient who is missing not only the second premolar, but also the first permanent molar (Fig 3). If some drifting of the adjacent teeth has occurred, the resulting edentulous space can be too large for a 1-tooth replacement and too small for a 2-tooth replacement. Then it could be advantageous to place a single-tooth implant in the appropriate position before orthodontic treatment. This implant can be restored and used as an anchor to close any excess and remaining space, by using the implant as an anchor to prevent unwanted occlusal changes in the remaining dentition. The advantage to the patient is that fewer restorations are required to fill the edentulous space. The advantage to the orthodontist is that an immobile anchor in the bone is available to protract or retract the adjacent teeth to close the space. This interdisciplinary treatment requires proper planning, the construction of a diagnostic wax-up, and precise positioning of the implant to satisfy the orthodontic, surgical, and restorative objectives (Fig 3).

If an implant is used to move adjacent teeth and close an edentulous space, the timing of implant loading is an important factor. In the past, implant loading traditionally was delayed until the implant had fully integrated with the surrounding bone. However, recent studies showed that early or immediate loading is possible, especially in orthodontic patients. The difference is that an orthodontic load is continuous and in 1 direction, whereas an occlusal load is intermittent and in different directions. Researchers have shown that a continuous load in the same direction actually stimulates bone formation, which further enhances the osseointegration of the implant. So, in most orthodontic situations, implants can be loaded early, soon after the restorative dentist has placed the temporary restoration.

Another alternative for treating a patient with congenitally missing mandibular second premolars is to simply close the space. If the patient has crowding in the opposite dental arch or a protrusive facial profile, closure of the edentulous space would be advantageous. However, in a patient with no dental crowding and a normal facial profile, closure of the edentulous space from a congenitally missing second premolar could produce an undesirable facial profile. In these situations, the orthodontist requires additional anchorage, either extraoral or intraoral, to prevent these unwanted facial changes. A protraction facemask and a chincup (Fig 4) are examples of extraoral appliances that will accomplish this type of tooth movement. Miniscrews and mini-implants are intraoral methods of providing additional anchorage to close these edentulous spaces without altering the patient’s facial profile. Another method of closing the edentulous space is to hemisect
the deciduous second molar at an early age\textsuperscript{21,22} and allow the permanent molar to erupt in a mesial direction without affecting the position of the mandibular incisors. If the orthodontist sees the patient at an early age and monitors him or her regularly, this alternative is especially attractive.

**SUMMARY**

We described and illustrated several methods of managing patients with congenitally missing mandibular second premolars. In the past, orthodontists primarily made the treatment decisions for these patients. However, with newer solutions for restoring edentulous spaces, surgeons and restorative dentists can play significant roles in helping to manage these orthodontic patients. Although the orthodontist sees the patient at a young age, some decisions made at that time will affect him or her for a lifetime. We emphasized the interdisciplinary aspects of treating a patient with congenitally missing mandibular second premolars to provide the best possible result that teamwork dentistry can offer.

**REFERENCES**